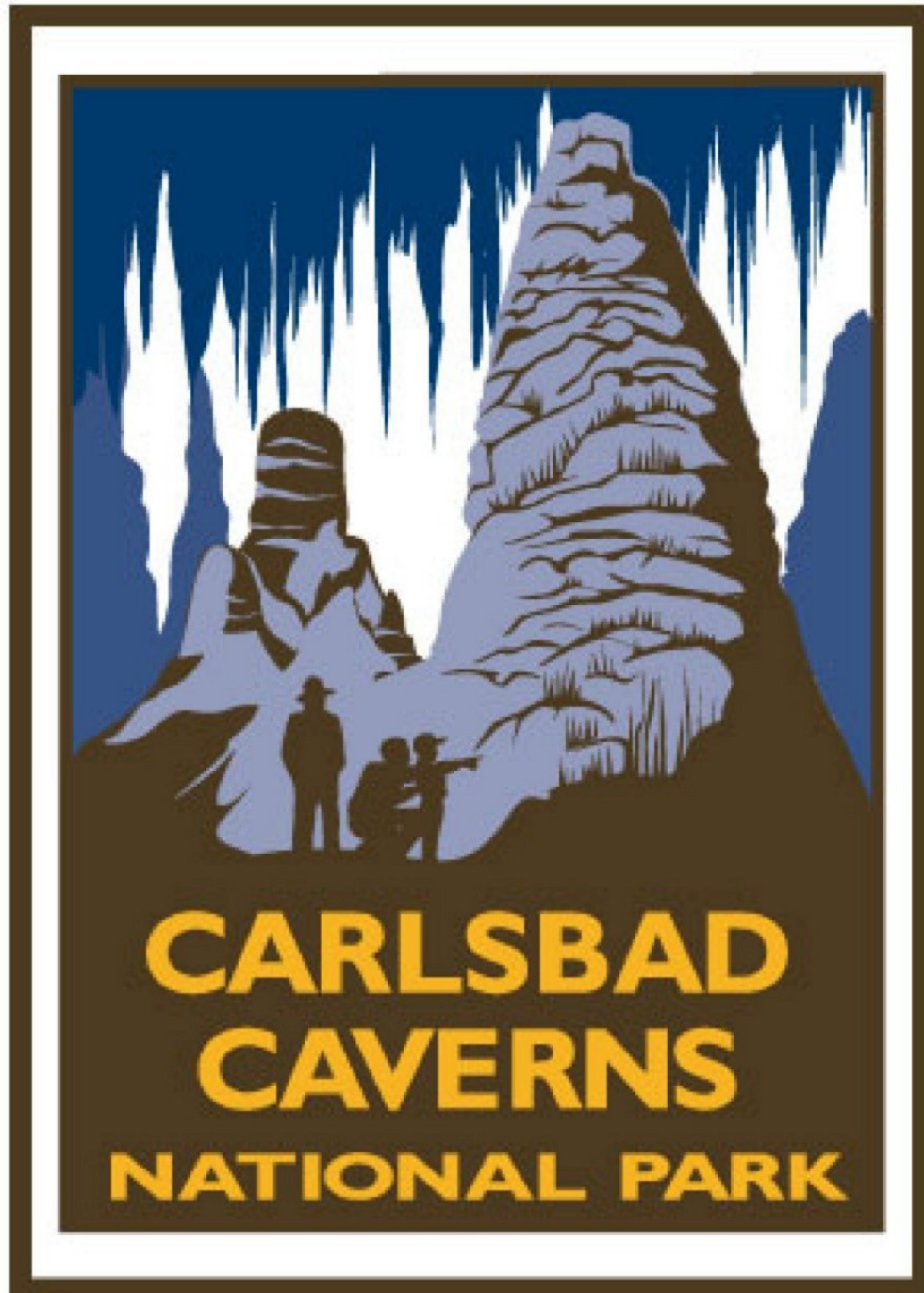


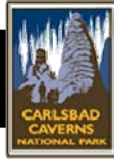
About Bats, Caves, & Deserts

A curriculum and activity guide for Carlsbad Caverns National Park



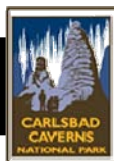
Elementary School





Section 5 – Bat Activities

- How About Those Bats?
- Comparing Bats and Birds
- Bat Wings
- Beneficial Bats Puppet Show
- Bat and Moth
- The Nose Knows
- What Big Ears You Have
- The Better to Hear You With, My Dear
- Bat Math Quiz
- Bat, May I?



How About Those Bats?

Pre-Visit or Post-Visit Activity

Primary/Elementary Level

Science (Life), Art (Unifying Concepts)

Two 45-Minute Sessions

Objective(s). Students will differentiate between myths and realities about bats.

Related NM Content Standards with Benchmarks. MA2-E2

Method. By reviewing background information and drawing pictures of bats, students learn more about these flying mammals.

Materials. graph with three columns, light colored construction paper, white construction paper, scissors

Key Vocabulary. myth, anatomy

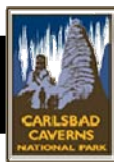
Background. Bats are unique animals. They are the only mammals that are true fliers. They have specialized wings that are made of tough skin. Bats have long *fingers* that spread and support the wings. The skeleton and soft anatomy in the wing of a bat may be directly compared to the arm and hand of a human. Bats live on all continents except Antarctica. They make up nearly a quarter of all animals on earth. There are nearly 1,000 species of bats. Carlsbad Caverns National Park has 15 species of bats. The park is famous for its large colony of Mexican free-tailed bats.

See "The Bats of Carlsbad Caverns and Elsewhere" in Section 2 – Just the Facts.

Suggested Procedure

1. Create a large graph that the entire class can see. You may want to use the blackboard. The graph should contain three columns: "I like bats" and "I don't like bats" and "I'm not sure."
2. Ask, "How do you feel about bats?" Give each student a 3" X 5" piece of white construction paper. Ask each student to draw a picture of a bat. When they have completed their pictures, allow them to place their pictures on the graph, indicating how they feel about bats.
3. After placing all the bats on the graph, ask students to state three things that are true about the graph. Discuss findings. Ask them to observe the details in the pictures. Encourage students to notice the similarities and differences in the illustrations.
4. Have each student fold a 9" X 12" piece of construction paper in half, lengthwise. Instruct students to fold the long slender rectangle in half and in half again.
5. Have students open the paper to the original fold. Place the fold away from you and open the flap. Cut along the other three fold lines up to the original fold.

6. Have students write a question about bats on the top of each of the flaps. When they have written their questions, have them open the flap and write information they may know about the question on the inside top of the flap.
7. At this time, do not have students write anything on the lower interior part. Collect the booklets for later use.
8. After the class has studied bats, have students write the answers to their questions on the inside of their booklets.



Comparing Bats and Birds

Pre-Visit or Post-Visit Activity

Primary/Elementary and Intermediate Levels

Science (Life)

30 Minutes

Objective(s). Students will compare and contrast bats and birds.

Related NM Content Standards with Benchmarks. SC10-E1, SC10-M2

Method. Students complete a chart deciding which animal has the characteristic listed.

Materials. copies of “Comparing Bats and Birds” student worksheet , pencils, illustrations and/or models of birds and bats

Key Vocabulary. compare, contrast, echolocation

Background. The bat is the only mammal that can truly fly. Birds fly, but they are in a separate scientific classification. Other than the characteristic of flight, are bats and birds alike in other ways? How are bats and birds different?

See “The Bats of Carlsbad Caverns and Elsewhere” in Section 2 – Just the Facts.

Suggested Procedure

1. Have students complete their student worksheets, with what they believe to be the characteristics of bats, birds or both.
2. Facilitate a class discussion comparing and contrasting the two animals, making a classroom *master* chart.
3. Use illustrations or models of birds and bats to emphasis the characteristics.

Key

Characteristics	Bat	Bird
The animal has an inside skeleton.	X	X
The animal has feathers.		X
The animal has fur.	X	
The animal makes a nest.		X
The animal hangs upside down to sleep.	X	
The animal lays eggs.		X
The animal gives birth to live babies.	X	
The animal has teeth.	X	
The animal has a beak.		X
The animal flies.	X	X
The animal uses echolocation to catch food.	X	
The animal breathes air.	X	X
The animal uses its eyes and ears to get food.	X	X

COMPARING BATS AND BIRDS

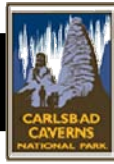
Student Worksheet

Name: _____

Date: _____

Directions: Place an **X** for the statements that are true for bats, birds or both.

Characteristics	Bat	Bird
The animal has an inside skeleton.		
The animal has feathers.		
The animal has fur.		
The animal makes a nest.		
The animal hangs upside down to sleep.		
The animal lays eggs.		
The animal gives birth to live babies.		
The animal has teeth.		
The animal has a beak.		
The animal flies.		
The animal uses echolocation to catch food.		
The animal breathes air.		
The animal uses its eyes and ears to get food.		



Bat Wings

Pre-Visit or Post-Visit Activity

Primary/Elementary Level

Science (Unifying Concepts, Life), Art (Visual)

45 Minutes

Objective(s). Students will illustrate the similarities of a bat skeleton and the human body.

Related NM Content Standards with Benchmarks. SC2-E3, SC10-E1

Method. Students construct a simplified model of the wing structure and body of a bat.

Materials. finished model of bat wings, copies of bat wing pattern, black or brown construction paper, white or manila paper, scissors, glue

Key Vocabulary. symmetrical, anatomy, skeleton

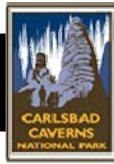
Background. Bats are unique animals; they are the only true flying mammals. Bat wings are actually modified arms. The bones are like those in a human arm and hands, except a bat has very long fingers. The wing's front edge is supported by the upper arm, forearm, second and third fingers. The rest of the wing is supported by the fourth and fifth fingers. The wing has two thin layers of flexible skin stretched between these fingers. The skin is so thin that you can almost see through it. The thumb of a bat is like a claw; it is used to help the bat move across rough surfaces of cave walls or tree bark.

See "The Bats of Carlsbad Caverns and Elsewhere" in Section 2 – Just the Facts.

Suggested Procedure

1. Facilitate a class discussion about how a bat's wing is like a human hand to assess what students already know. Let them share ideas. Show students the bat wing pattern. Bats have many more bones in their wings than the pattern shows. Because a bat is symmetrical, it will usually have the same number of bones on both sides of the body at approximately the same location.
2. Make copies of the bat wing pattern. Give each student a copy of the bat wing pattern, a sheet of black or brown construction paper, a sheet of white or manila construction paper, scissors and glue.
3. Have students cut out wings and trace them twice onto the construction paper. Instruct students to cut out the two wings. Then have them cut out the bat wing bones from the pattern piece and trace them twice onto the white or manila paper and cut along tracings.
4. Using the finished model of the bat wings for reference and to self-correct, students glue the *arm* and *finger* bones on the wings in their proper locations. When students have completed their bat wings, have them put their names on the backs of both wings. Collect wings for use in the *Beneficial Bats Puppet Show*.

BAT WINGS PATTERN



Beneficial Bats Puppet Show

Pre-Visit or Post-Visit Activity

Primary/Elementary Level

Science (Life), Language Arts (Unifying Concepts, Expressive Language),

Art (Visual, Theatre)

Four 40-Minute Sessions

Objective(s). Students will identify at least three ways bats are beneficial.

Related NM Content Standards with Benchmarks. SC10-E1, LA2-E1, LA5-E3, LA5-E5, AE1-E10, AE1-E15, AE3-E11

Method. Students script and perform in a puppet show to illustrate the benefits of bat conservation.

Materials. finished bat puppet, copies of bat pattern, paper lunch bags, glue, scissors, student's bat wings from the "Bat Wings" activity

Key Vocabulary. symmetry, anatomy, pollinate

Background. Bats have been the subject of much misrepresentation and bad publicity. Maybe it is due to their ability to fly. Or maybe it is because of the places they inhabit, such as caves. But for whatever reason, bat species are declining at an alarming rate, mostly due to human impact. Bats are beneficial to man and the environment. They have a vital role in the balance of nature—controlling the night-flying insect populations, scattering seeds for new plant growth and pollinating plants. Therefore, people need to help keep bat populations stable.

See "The Bats of Carlsbad Caverns and Elsewhere" in Section 2 – Just the Facts.

Suggested Procedure for Session One

1. Give each student a copy of the bat pattern, a paper lunch bag, scissors and glue.
2. Have students cut out the bat body parts from the pattern. Place the lunch bag with the flap up and the opening down.
3. Using the finished puppet for reference and to self-correct, have students glue the bat's body parts in their proper locations. The eyes and nose are glued on the flap, with the flap acting as the mouth. (Do not glue the flap down.) Glue the ears on the back of the bag, so they stick up above the head. The feet are glued near the opening of the bag.
4. Give each student his/her own pre-made bat wings from the *Bat Wings* activity. Have students glue the wings in the side folds of the lunch bag.

Suggested Procedure for Session Two

1. Divide students in groups of four.

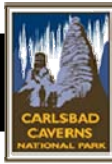
2. Instruct each group to write a funny, short script to explain how bats benefit people. Students will be either bats and/or people—according to the script. Allow students to write their lines on index cards.

Suggested Procedure for Session Three. Have students practice and rehearse their shows.

Suggested Procedure for Session Four. Have students conduct their puppet shows for the lower elementary grades.

PAPER BAG PUPPET PATTERN

Bat



Bat and Moth

Pre-Visit or Post-Visit Activity

Primary/Elementary Level

Science (Unifying Concepts, Life)

45 Minutes

Objective(s). Students will demonstrate how insectivorous bats catch prey in the dark.

Related NM Content Standards with Benchmarks. SC2-E3, SC10-E1

Method. Through physical activity, students simulate how a bat uses echolocation to find its prey.

Materials. blindfolds

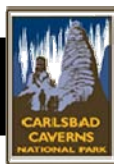
Key Vocabulary. echolocation, insectivorous

Background. Some bats make a high pitched squeaking sound to find insects. These sounds (usually too high-pitched for human ears to hear) bounce off objects in their path. Bats are able to determine what an object is and their distance from it, simply by listening to their own echoes. Bat also make noises that human can hear—clickings, whinings and squeaks. A bat echolocation tape is available through Bat Conservation International in Austin, Texas.

See “The Bats of Carlsbad Caverns and Elsewhere” in Section 2 – Just the Facts.

Suggested Procedure

1. Blindfold one student. He/She will be the *bat*. Designate 4 to 6 other students to be *moths*. The remaining students form a circle around the bats and moths.
2. Both the *bat* and the *moths* can move. The *bat* calls out “bat,” and the *moths* respond “moth.” Using the sounds, the *bat* must find and tag the *moths*. Tell students that every time the *bat* calls out “bat,” he/she is pretending to be a bat sending out a high-pitched sound. When the *moths* reply “moth,” they are pretending to be the bat’s echo bouncing off the moth and back to the bat’s ears. As the moths are tagged, they join the students forming the circle.
3. Another variation is to add another *bat*. Be sure they do not collide with one another. Try adding some *trees*. When the *bat* calls out “bat,” the *trees* respond “tree.” The *trees* must stand still. If a *bat* runs into a *tree*, the student must join the students in the circle.



The Nose Knows

Pre-Visit or Post-Visit Activity

Primary/Elementary Level

Science (Unifying Concepts, Life)

1 Hour

Objective(s). Students will model how a mother bat finds her own baby among hundreds of pups.

Related NM Content Standards with Benchmarks. SC2-E3, SC10-E1

Method. Using scents and sounds, students theorize how a mother bat finds her pup.

Key Vocabulary. mammal, pup, colony

Materials. cinnamon oil, clove oil, mint extract, vanilla extract, lemon extract, construction paper, yarn, scissors, blindfold

Background. Many mother mammals use the sight, sound, taste and smell of their young to recognize them as soon as they are born. In a cave environment, mother bats cannot use sight to recognize their babies. It is theorized that mother bats identify their young by using sound and smell.

In Bat Cave, at Carlsbad Caverns National Park, Mexican free-tailed bats hang upside down touching each other, covering the ceiling in single-layered groups with up to 500 pups (baby bats) huddled together in one-square-foot space. This closeness raises the temperature of the cave, keeping the pups warm while their mothers are flying the night skies in search of food. Upon returning to the cave, each mother bat finds her own baby in total blackness. How can this be?

See “The Bats of Carlsbad Caverns and Elsewhere” in Section 2 – Just the Facts.

Suggested Procedure

1. Explain to students what a nursery colony is and what would life be like.
2. Have each student draw a bat on the construction paper and cut it out. Using the yarn, make a necklace from the paper bat.
3. Designate 5 students to be *adult bats*. Designate 5 other students as *pups*. Have students leave the classroom. Place a couple of drops of cinnamon oil onto one of the adult necklaces. Using the same oil, place a couple of drops onto one of the baby necklaces. Repeat this step using the various scents to pair adult necklaces with baby necklaces.
4. When students return to the classroom, tell them you have put a scent on their *bats*, and they are not to discuss their scent with each other. Separate the *adults* and *pups*. Have each student put on their bat necklace. On one side of the room have the *pups* line up against the wall. On the other side of the room, blindfold *one adult*. Tell the *adult* to walk

across the room and find the *pup* that matches his/her scent. Record how long it takes to find the matching *pup*. Next, blindfold the second *adult* and repeat the process. Continue until each *adult* has found its own *pup*. Repeat #3 and #4 to allow 10 other students to participant.

5. Have the original 10 students trade necklaces and reverse their previous roles. Pair each *new adult* with its correct *pup*. Have each pair agree on a special click.
6. Have *pups* go to one side of the room. Blindfold the first *adult* on the other side of the room. Mix *pups* around. Have *pups* do their special click quietly. The *adult* will try to find its *pup* by using not only scent, but also sound. Have each blindfolded *adult* find its *pup*. Record the time it takes for the *adult* to find the *pup*. Is it quicker than with just smell alone? Repeat #5 and #6 to allow the second group of 10 students to participate.
7. Have the original 10 students once again trade necklaces. Pair each *adult* with its own *pup*. And again ask them to agree upon a click sound. Allow each *adult* to place its *pup* in a position along the wall. All the *pups* can then pick a spot along the wall. The *adult* is then blindfolded and sets off to find the *pup* using smell, hearing (the clicks) and memory. Allow each *adult* to find its *pup*. Record the time it takes for each adult to find its pup. Is it quicker than the previous ways? Repeat #7 to allow the second group of 10 students to participate.



What Big Ears You Have

Pre-Visit or Post-Visit Activity

Primary/Elementary Level

Science (Unifying Concepts, Physical, Life)

15 Minutes

Objective(s). Students will model and describe sound waves. They will then describe how a bat uses sound waves for survival.

Related NM Content Standard with Benchmarks. SC2-E3, SC9-E1, SC10-E1

Method. Students illustrate sound waves using water.

Materials. tape player, tape of soft music, glass pan or clear container, water, dropper filled with water, overhead projector

Key Vocabulary. sound waves, sonar system, echolocation

Background. Although bats are not blind, most of them (70%) use a sonar system, called echolocation, to navigate in the dark. The sound that these bats make are high-pitched—most too high for people to hear. As the sound waves coming from the bat hit objects (trees, buildings, people or potential food), they are reflected back as echoes and are collected by the bat's ears. Using sound alone, the bat can tell the size, texture and even the direction of a moving insect. Echolocation tells a bat, not only the location of the object, but what the object is.

See "The Bats of Carlsbad Caverns and Elsewhere" in Section 2 – Just The Facts.

An echolocation tape is available through Bat Conservation International in Austin, Texas.

Suggested Procedure

1. Have students close their eyes. Play a tape of soft music. Next have students cup their hands behind their ears and continue to listen.
2. Ask students the following questions:
 - "Does cupping your hands behind your ears help you hear the music better?"
 - "How are your cupped hands like a bat's big ears?"
 - "Why do you think a bat has such big ears?"
3. Fill the pan with about one inch of water. Place the pan on the overhead projector. Turn the projector on and let the water settle. When the water is calm, instruct a student to drop a couple of drops of water from the dropper into the middle of the pan.
4. Ask students the following questions:
 - "What happened?"
 - "Could you see the ripples move out from the source?"

“What happened when the water waves reached the edges of the pan?”

“Compare the water waves to sound waves from a bat.”

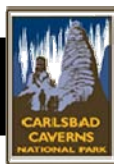
5. Ask who has witnessed a bat flight program at Carlsbad Caverns National Park. Ask the following questions to those who have witnessed a bat flight.

“Did you hear the bats echolocate?” (No.)

“Did you see any of the bats hit trees, people or other bats?” (No.)

“Were you close enough to hear the bats just before you saw them?”

“If you answered yes, what sound did you hear?” (Suggest wings flapping, clicking, whining or squeaks.)



The Better to Hear You With, My Dear

Pre-Visit or Post-Visit Activity

Primary/Elementary and Intermediate Level

Science (Unifying Concepts, Physical, Life)

45 Minutes

Objective(s). The students will illustrate basic wave patterns.

Related NM Content Standards with Benchmarks. SC9-E1, SC9-M1

Method. Using water and a wave generator, students sketch sound wave behaviors in various situations.

Materials. overhead projector, screen, ripple tank, water, wave generator with parallel-wave and circular-wave attachments, various types of barriers for the tank

Background. Review the different types of wave behavior (interference, refraction, reflection, diffraction).

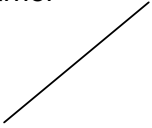







See “The Bats of Carlsbad Caverns and Elsewhere” in Section 2 – Just the Facts.

Suggested Procedure

1. Set up the equipment, using enough water to completely cover the bottom of the tank and still obtain a clear image of wave fronts on the screen. It may be necessary to readjust the focusing after the tank is filled with water. CAUTION: Spilled water may damage equipment and cause electrical shock. Unplug immediately, if water spills.
2. Set up barriers and waves for each situation.
 - straight-line waves
 - parallel straight-line waves off a straight barrier
 - parallel straight-line waves moving towards a triangular glass plate
 - circular (curved waves)
 - reflection of curved waves off a straight barrier
 - reflection of curved waves of a convex barrier
 - interference of curved waves from two wave sources
3. Have students sketch the resulting waves on the student worksheet. It may be easier to start with a single pulse before generating a steady wave train.

OBSERVATION OF SOUND WAIVES Student Worksheet

Sketch and label the wave patterns produced in each of the situations demonstrated in the ripple tank.

<p>straight generator</p>	<p>barrier</p>  <p>straight generator</p>	<div data-bbox="695 474 935 581" style="border: 1px solid black; padding: 2px;"> <p>glass plate on bottom</p> </div> <p>straight generator</p>	<p>Barriers</p> <p>-----</p> <p>straight generator</p>	
<p>circular generator</p> 	 <p>circular generator</p> 	 <p>circular generator</p> 	 <p>circular generator</p> 	



Bat Math Quiz

Pre-Visit or Post-Visit Activity

Intermediate Level

Science (Life), Mathematics (Unifying Concepts, Statistics)

30 Minutes

Objective(s). Students will solve bat-related math problems, and then draw and write conclusions based upon their answers.

Related NM Content Standards with Benchmarks. SC10-M1, MA1-M1, MA1-M6, MA4-M4, MA10-M3

Method. By solving math problems, students draw several conclusions about bats.

Materials. paper, pencil

Background. After solving the math problems, students should draw the following conclusions:

- An active bat's heart beats much faster than an active human heart.
- A bat's heartbeat is dramatically slower when it hibernates. (Carlsbad Cavern's famous colony of Mexican free-tailed bats does not hibernate. When the weather turns cool, they fly south for the winter.)
- Some bat species eat a lot of harmful insects. (Most species of bats are insect-eaters. Carlsbad's Mexican free-tails eat mostly moths. Research is currently being conducted to estimate how many thousands of bats live in Bat Cave. One can only try to image the tons of moths that these bats eat.)
- See "The Bats of Carlsbad Caverns and Elsewhere" in Section 2 – Just the Facts.

Suggested Procedure for Question One and Two. Tell students that a human's active heartbeat is about 150 times per minute. An active bat's heartbeat averages 900 beats per minute.

- When compared to a human, how many more beats does the bat make per minute?
Answer: 750
- How many times does a bat's heartbeat a second? Answer: 15

Suggested Procedure for Question Three. Tell students that when the average bat hibernates, its heart rate drops to about 20 beats per minute.

- How many times will a hibernating bat's heart beat in one day (24 hours)? Answer: 28,800
- What do you think would happen to hibernating bats, if human activity woke them frequently? What is your explanation for the answer you gave?

Suggested Procedure for Question Four, Five and Six. Tell students that insectivorous bats can eat half their weight in insects each night.

- If the bat weights 16 grams and a moth weights 0.4 grams, how many moths will the bat eat before it is full? Answer: 20
- If the bat ate only moths, how many moths could it eat from May to September (150 days)? Answer: 3,000
- How many could a colony of one billion bats eat? Answer: 3 billion
- Why do farmers like bats? Why should everyone like bats?



Bat, May I?

Pre-Visit or Post-Visit Activity

Primary/Elementary Level

Science (Life)

30 Minutes

Objective(s). Students will recall answers to a variety of bat-related questions.

Related NM Content Standards with Benchmarks. SC10-E1, SC11-E1, SC11-E6

Method. Students play a game of *Bat, May I?* as a review of the information they have learned about bats.

Background. See “The Bats of Carlsbad Caverns and Elsewhere” in Section 2 – Just the Facts.

Suggested Procedure

1. Divide students into two or more groups. Groups are to stand in the middle of the playing field.
2. The leader will ask bat-related questions. The first group decides how many steps to the finish line they are willing to risk (up to 3 steps). The leader then asks a bat-related question. The group asks, *Bat May I?* (The leader should respond, *Yes, you may.*) The group gives its answer. If the group answers correctly, then they may advance the number of steps they were willing to risk. If they answer incorrectly, then they must go back the number of steps they risked. The second question goes to group two. Once again they decide how much to risk and a question is asked. After saying *Bat, May I?* and answering the question, they either advance or retreat. The third question goes to the next group and so on. The group who arrives at the finish line first wins the game.